SUBSECTION 8.15

Geologic Hazards and Resources

8.15 Geologic Hazards and Resources

8.15.1 Introduction

This subsection evaluates the effect of geologic hazards and resources that might be encountered on the project site. The objective of this evaluation is to identify site conditions and the potential impacts from the construction or operation of the project. This section presents a summary of the relevant laws, ordinances, regulations, and standards (LORS); the existing site conditions; and the expected direct, indirect, and cumulative impacts because of construction, operation, and maintenance of the project; proposed mitigation measures and the effectiveness and monitoring plans; and required permits and permitting agencies.

8.15.2 Laws, Ordinances, Regulations, and Standards

The LORS that apply to geologic hazards and resources are summarized in Table 8.15-1.

TABLE 8.15-1
Laws, Ordinances, Regulations, and Standards

Jurisdiction	Authority	Administering Agency	Compliance
Local	Uniform Building Code (UBC), 1997, Appendix Chapter 16, Division 4	City and County of San Francisco	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity
State	California Building Code (CBC), 2001	City and County of San Francisco	

8.15.3 Affected Environment

The proposed San Francisco Electric Reliability Project (SFERP) site is a 4.0-acre parcel near Potrero Point in the Potrero District of the City of San Francisco (City). The project site is located along the eastern side of the San Francisco Peninsula, near the San Francisco Bay (the Bay) and north of the Islais Creek Channel between Cesar Chavez Street and 25th Street. The San Francisco Peninsula lies within the northern Coast Ranges physiographic province. This province is characterized by a northwest-trending series of elongated ranges and narrow valleys and extends from the Oregon border to the Transverse Ranges in Southern California (Norris and Webb, 1990).

The proposed SFERP site is relatively flat (approximately 13 feet above mean sea level) and is underlain by Franciscan-age bedrock and older alluvial deposits, and locally by artificial fill. The entire site is reclaimed tidal flats (Older and Younger Bay Muds and estuary deposits). A process water supply linear that is approximately 0.76 miles long will also be installed, originating from Marin Street and Mississippi Street where a Water Pump Station will be located. An approximately 300-foot-long potable water supply line will interconnect the SFERP to the City’s potable water pipeline located in Cesar Chavez Street due south of the project site. The electricity produced by the project will be transmitted to the PG&E Potrero Substation via approximately 3,000 feet of underground transmission lines.

The project area is considered to be seismically unstable and is designated as a California UBC Seismic Zone 4.

8.15.3.1 Regional Geology

The geology of the SFERP vicinity is complex, largely a result of the interaction of the strike-slip tectonics of the San Andreas fault system and the compressional tectonics of the Coast Ranges. The Coast Ranges are composed of a series of parallel, northwesterly trending folded and faulted ranges and represent structural blocks comprised of a variety of lithologic types. These structural blocks are juxtaposed by major geologic structures. The San Andreas fault zone lies to the west (approximately 7 miles) and is a major boundary that separates the Franciscan Complex rocks of the North American Plate from the Salinian basement rocks of the Pacific Plate.

8.15.3.2 Local Geology

The site is situated southeast of the Potrero Hill rock mass that is composed of serpentine bedrock of the Franciscan Formation. Quaternary to Holocene alluvial and estuarine deposits along with recent artificial fill overly the bedrock deposits. The entire site has been reclaimed through the placement of artificial fill since the mid-1800s. The geology within a 2-mile radius of the site is presented on Figure 8.15-1 (figures are located at the end of this subsection).

A geotechnical investigation was performed in 1999 by AGS, Inc. at the proposed San Francisco Municipal Railway (MUNI) Metro East Light Rail Vehicle Maintenance and Operations Facility that is located immediately west of the proposed SFERP site. Several of the eastern borings drilled as part of that assessment were located on the proposed SFERP site (AGS, Inc., 1999). Data collected from that investigation has been used to support preliminary site conditions presented herein until a site-specific geotechnical investigation for the SFERP site can be conducted.

8.15.3.3 Stratigraphy

8.15.3.3.1 Franciscan Basement. The SFERP site is located within the Hunters Point Shear Zone within the Franciscan Complex and is primarily comprised of serpentinite. Large zones of serpentinite and brecciated materials from previous periods of deformation are characteristic of the Franciscan formation.

8.15.3.3.2 Quaternary Alluvial and Fluvial Deposits. Alluvial deposits that overlay the Franciscan bedrock at the site were derived from topographic highs around the site. Lithologic types present include gravelly and clayey sands, and sandy clays. Bay Mud, associated with estuarine deposits, also overlies the bedrock. Artificial fill consists of a mixture of sand, gravel, and silt, with rubble and debris (e.g. bricks, concrete, wood, and re-worked bedrock). Artificial fill was present immediately below the ground surface in all borings (AGS, Unc., 1999).

8.15.3.3.3 Structure. The site is located within the Hunters Point Shear Zone on the northern edge of the San Francisco Peninsula. This shear zone is an older structure (Jurassic) that trends northwest across the Peninsula and has been deformed by translations and movement along the San Andreas Fault system (Dames and Moore, 2000).

The California Geological Survey (CGS) does not consider the shear zone active. A geophysical study performed by the United States Geological Survey (USGS) suggested that the shear zone was inactive during the late Pleistocene and Holocene eras (Dames and Moore, 2000).

The San Andreas Fault system is the most notable geologic structure in the site area. The fault system includes primary, secondary, and thrust faults that trend northwest in the regional area and are capable of producing large magnitude earthquakes.

8.15.3.4 Seismicity

The project site lies within the San Andreas Fault system region that separates the North American and Pacific plate boundaries. This boundary has been the site of numerous large-scale earthquakes. The area is considered seismically active. However, the site is not located within a special study zone, as delineated by the Alquist-Priolo Special Studies Zone Act of 1972; and no known fault, active or inactive, reaches the surface within the project area (Jennings, 1994). The significant faults in the San Francisco Bay area are described below and are shown on Figure 8.15-2.

8.15.3.4.1 San Andreas Fault. The nearest major fault is the San Andreas fault, which is approximately 7 miles west of the site. This fault is the largest active fault in California and extends from the Gulf of California to Cape Mendocino in northern California. The San Francisco moment magnitude (Mw) 7.9 earthquake of 1906 was attributed to this fault. The fault was previously divided into 3 segments, however the recommendation of the Working Group on Northern California Earthquake Potential (WGNCEP, 1996) was to subdivide the fault into 4 segments (the section of the fault north of Point Arena is now referred to as the Offshore segment). The primary three segments are located in the San Francisco Bay Area (North Coast, Peninsular, and Southern Santa Cruz Mountains) and have recently been assigned individual maximum credible earthquakes (MCEs) of Mw 7.5, Mw 7.2 and Mw 7.0, respectively, by the Working Group on Northern California Earthquake Potential (WGNCEP, 2003). The same working group identified the MCE for all 4 segments combined, as is thought to be the cause of the 1906 earthquake, to be Mw 7.9. According to the WGNCEP (2003), there is a 21 percent probability of a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.4.2 San Gregorio Fault. West of the San Andreas fault is the San Gregorio fault. This fault is approximately 11 miles from the project site and is considered to be an active Holocene fault. It is approximately 80 miles long and runs from Big Sur to the Golden Gate Bridge. Most of the fault is offshore, but several areas are onshore. The MCE from this fault is Mw 7.3 (WGNCEP, 2003). According to the WGNCEP (2003), there is a 10 percent probability of a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.4.3 Hayward and Rodgers Creek Fault. The Hayward and Rodgers Creek Fault System lies approximately 11 miles east of the site, across San Francisco Bay. The fault system is considered to include the northern and southern Hayward Fault system as well as the Rodgers Creek fault, and extends from Healdsburg south to Fremont (WGNCEP, 2003). It is approximately 87 miles long and is considered by the WGNCEP to be the most likely source of the next major earthquake of the Bay Area (WGNCEP, 1996). The 1868 local magnitude 6.8 Mw earthquake was the last major earthquake on the Hayward fault. A MCE Mw of 6.9

has been assigned to the simultaneous rupture of the northern and southern segments of the Hayward fault (WGNCEP, 2003). A simultaneous rupture of the three segments that make up this fault system has been assigned a MCE of Mw 7.3. According to the WGNCEP (2003), the Hayward and Rodgers Creek fault system has a 27 percent probability of generating a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.4.4 Calaveras Fault. The Calaveras fault lies approximately 22 miles east of the site. It is approximately 76 miles long and contains three identified segments that extend from Hollister to Danville. MCEs assigned for the three segments range from Mw 5.8 and Mw 6.2 for the southern and central segments, respectively, to Mw 6.8 for the northern segment (WGNCEP, 2003). Combined, the fault is assigned an MCE of Mw 6.9. According to the WGNCEP (2003), there is an 11 percent probability of a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.4.5 Concord-Green Valley Fault Zone. The Concord-Green Valley fault is located approximately 25 miles to the northeast of the site. It is a 35-mile long right-lateral strike-slip fault that extends from Walnut Creek north across Suisun Bay to Wooden Valley WGNCEP (2003). The MCE previously assigned to the assumed 2 segments of this fault system was Mw 6.9 (WGNCEP, 1999). According to the WGNCEP (2003) the fault system actually comprises 3 individual segments with a combined MCE of Mw 6.7. According to the WGNCEP (2003), there is a 4 percent probability of a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.4.6 Greenville-Marsh Creek Fault. The Greenville-Marsh Creek fault is located approximately 29 miles east of the site. The fault is a northwest-striking strike-slip fault approximately 35 miles long in the northern Diablo Range. The MCE assigned for this two-segment fault is Mw 6.9 (WGNCEP, 2003). According to the WGNCEP (2003), there is a 3 percent probability of a Mw 6.7-equal or greater earthquake within 30 years along this fault.

8.15.3.5 Geologic Hazards

A site-specific geotechnical investigation will be conducted to support design engineering for the project. Results of the investigation will be provided upon request.

The following subsections discuss the potential geologic hazards that might occur in the project area.

8.15.3.5.1 Ground Rupture. Ground rupture is caused when an earthquake event along a fault creates rupture at the surface. Since no known faults exist at the project site, the likelihood of ground rupture to occur at the project site is low.

8.15.3.5.2 Seismic Shaking. The San Francisco Bay Area has experienced strong ground motion in the past and will do so in the future. Analysis by the computer program EQFault (Blake, 2000), a deterministic estimation of peak acceleration from digitized faults based on the 1996 fault maps, indicates that peak horizontal geologic hazard at the SFERP site is strong ground-shaking due to an earthquake. Mualchin (1996) estimated that the ground-shaking of a Mw 8.0 earthquake along the San Andreas fault system could produce peak ground gravity (g) acceleration of up to 0.4 g in the vicinity of the SFERP. For the MUNI site immediately to the west, AGS reported that a peak horizontal ground surface acceleration of

0.55 g could be possible for the site – based on causative fault and mean values of the peak bedrock accelerations and the effect of local soil conditions (AGS, Inc., 1999). A copy of the Final Geotechnical Study Report for the MUNI Metro East Light Rail Vehicle Maintenance and Operation Facility is contained in Appendix 8.15. The USGS seismic hazard mapping web site (USGS, 2002) indicates that the peak horizontal ground acceleration could be as high as 0.53 g based on the 1996 seismic hazard map using a latitude/longitude site-specific search (USGS, 2002).

8.15.3.5.3 Liquefaction. During strong ground-shaking, loose, saturated, cohesionless soils can experience a temporary loss of shear strength. This phenomenon is known as liquefaction. Liquefaction is dependent on grain size distribution, relative density of the soils, degree of saturation, and intensity and duration of the earthquake. The potential hazard associated with liquefaction is seismically induced settlement. The depth to groundwater at the project site is relatively shallow, approximately 5 to 7 feet, and the soil types generally consist of loose to medium dense sandy and gravelly fill soils of unknown origin up to approximately 20 feet thick (AGS, Inc., 1999). Therefore, the likelihood that liquefaction will occur is considered potentially high.

8.15.3.5.4 Mass Wasting. Mass wasting depends on steepness of the slope, underlying geology, surface soil strength, and moisture in the soil. Significant excavating, grading, or fill work during construction might introduce mass wasting hazards at the SFERP site. Because the SFERP site is relatively flat and no significant excavation is planned during site construction, the potential for direct impact from mass wasting at the site is considered low to negligible.

8.15.3.5.5 Subsidence. Subsidence can be a natural or man-made phenomenon resulting from tectonic movement, consolidation, hydrocompaction, or rapid sedimentation. Organic soils, typical of marsh deposits, would not be expected to be present as that original shoreline is approximately 3,000 feet to the west of the site. Given that the site is underlain by fill that directly overlays bay mud and the lack of organic soils identified in borings drilled near the site, the potential for subsidence, as a hazard that could affect the project site, is low.

8.15.3.5.6 Expansive Soils. Expansive soils shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. Site-specific borings advanced in the vicinity of the project site have identified fill and Bay Mud (AGS, Inc., 1999). In addition, the depth to water is relatively shallow and significant shrink-swelling would not be expected. Based on these, the likelihood of expansive soils to be present at the site is low.

8.15.3.5.7 Geologic Resources of Recreational, Commercial, or Scientific Value. Geologic resources of recreational, commercial, or scientific value in the project vicinity that could be affected include aggregate and gas reserves. Geologic resources of value are discussed in the next paragraph.

8.15.3.5.8 Aggregate Resources. In 1987, the California Division of Mines and Geology performed a mineral land classification of the San Francisco-Monterey Bay Area. According to the published report, the entire SFERP site was classified as Mineral-Resource Zone (MRZ)-1, defined as “areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence" (Dames and Moore, 2000). Two areas nearby were classified as MRZ-2, where "significant mineral deposits are present." These are in the Bernal Heights area and near Candlestick Point. However, neither of these two locations is under development.

8.15.3.5.9 Natural Gas. No oil or gas fields are present in the project vicinity, according to online maps from the State of California Division of Oil, Gas and Geothermal Resources (CDOGGR, 2003).

There are no known geologic resources that provide a significant scientific or recreational value in the vicinity of the site.

8.15.4 Environmental Impacts

8.15.4.1 Generating Facility

8.15.4.1.1 Geologic Hazards. Ground-shaking presents the most significant geologic hazard to the proposed SFERP site and project linear. Table 8.15-2 summarizes the geologic hazards associated with the SFERP.

TABLE 8.15-2
Summary of Potential Geologic Hazards

Project Component	Area of Potential Concern	Geologic Hazards of Potential Concern
Proposed generating facility site (up to 4.0 acres)	Entire site	Seismic ground-shaking, liquefaction
Project linears	Entire site	Seismic ground-shaking, liquefaction

8.15.4.1.2 Geologic Conditions and Topography. Construction will require minor grading and excavation, thereby altering the terrain of the SFERP site. Impacts on the geologic conditions involve changes in drainage, cuts, and fills. Since the site is generally level, site grading is not expected to adversely impact the geologic environment.

8.15.4.2 Geologic Resources of Recreational, Commercial, and Scientific Value

No known natural resources occur in the SFERP site area. The two MRZ-2 areas identified near Bernal Heights and Candlestick Point are not being actively developed. No significant impact to geologic resources would occur with the project.

8.15.5 Mitigation Measures

The following subsections describe mitigation measures that could be used to reduce impacts from geologic hazards.

8.15.5.1 Ground Rupture

No active faults cross the SFERP site or project linear (Jennings, 1994). Therefore, no mitigation measures are required to reduce the hazard from surface faulting rupture.

8.15.5.2 Ground-Shaking

The SFERP site and project linear will need to be designed and constructed to withstand strong earthquake-shaking as specified in the 2001 CBC for Seismic Zone 4. A site-specific geotechnical investigation (forthcoming) will aid in the development of the seismic design criteria.

8.15.5.3 Liquefaction

The soil types present at the SFERP site and along the project linear may be conducive to liquefaction. A site-specific geotechnical investigation currently being planned will aid in the assessment of liquefaction potential and lateral spreading. Pile and foundation design will consider the results of the assessment as described in Appendix 10G.

8.15.5.4 Subsidence

Based on site-specific data, subsidence is not considered to be a hazard at the site and mitigation would not be required.

8.15.5.5 Expansive Soils

Expansive soils can be mitigated by removing the soil and backfilling with non-expansive soil, instituting chemical stabilization of the soil, or constructing a foundation treatment that resists uplift of the expansive soil. Previous borings drilled at the site have not identified soils that would be prone to expansion. As a result, mitigation measures would not be required at the site.

8.15.6 Involved Agencies and Agency Contacts

No permits are required for compliance with geological LORS. However, the City and County of San Francisco Building Department is responsible for enforcing compliance with building standards.

8.15.7 Permits Required and Permit Schedule

Compliance of building construction with UBC standards is covered under engineering and construction permits for the project. There are no other permit requirements that specifically address geologic resources and hazards. However, excavation/grading and inspection permits will be required prior to construction and will be included in the overall project construction permit. Borings for the design engineering geotechnical investigation will require a permit from the Department of Public Health. Required permits and agency contact information is summarized in Table 8.15-3.

TABLE 8.15-3
Permits and Agency Contact Information

Agency	Contact	Telephone
City and County of San Francisco Department of Environmental Health—Monitoring Well Unit	Larry Kessler—Inspector	(415) 252-3841

8.15.8 References

AGS, Inc. 1999. Geotechnical Study Report, MUNI Metro Rail Light Rail Vehicle Maintenance and Operations Facility. Final. August.

Blake, T. 2000. EQFAULT, Thomas F. Blake Computer Services and Software. Thousand Oaks, California.

CDM (Camp Dresser & McKee, Inc.). 1997. Phase I Environmental Site Assessment. Potrero Power Plant, City and County of San Francisco, California. Prepared for Pacific Gas and Electric. October.

CDMG (California Division of Mines and Geology). 2000. Seismic Hazard Evaluation of the City and County of San Francisco, California, Open-File Report 2000-009.

CDOGGR (California Division of Oil, Gas, and Geothermal Resources). 2003. Oil and Gas Field Maps. http://www.consrv.ca.gov/dog.

Dames and Moore. 2000. Application for Certification. Potrero Power Plant Unit 7 Project. Section 8.15, Geologic Hazards and Resources. Prepared for Southern Company.

Geomatrix. 2000. Report of Additional Site Characterization. Potrero Power Plant Site. April.

Jennings, C. W. 1994. Fault Activity Map of California and Adjacent Areas. Division of Mines and Geology.

Mualchin, L. 1996. A Technical Report to Accompany the Caltrans California Seismic Hazard Map. Prepared for Caltrans by the Office of Earthquake Engineering. July.

Norris, R. M. and R. W. Webb. 1990. *Geology of California.* Second Edition. John Wiley and Sons. New York.

USGS (United States Geological Survey). 2002. National Seismic Hazard Mapping Project. http://geohazards.cr.usgs.gov/eq/.

WGNCEP (Working Group on Northern California Earthquake Potential). 1996. Database of Potential Sources for Earthquakes Larger than Magnitude 6 in Northern California. U.S. Geological Survey. Open-file report 96-705.

WGNCEP (Working Group on Northern California Earthquake Potential). 1999. Earthquake Probabilities in the San Francisco Bay Region: 2000 to 2030 – A Summary of Findings. U.S. Geological Survey. Open-File Report 99-517.

WGNCEP (Working Group on Northern California Earthquake Potential). 2003. Earthquake Probabilities in the San Francisco Bay Region: 2002–2031. U.S. Geological Survey. Open-File Report 03-214.

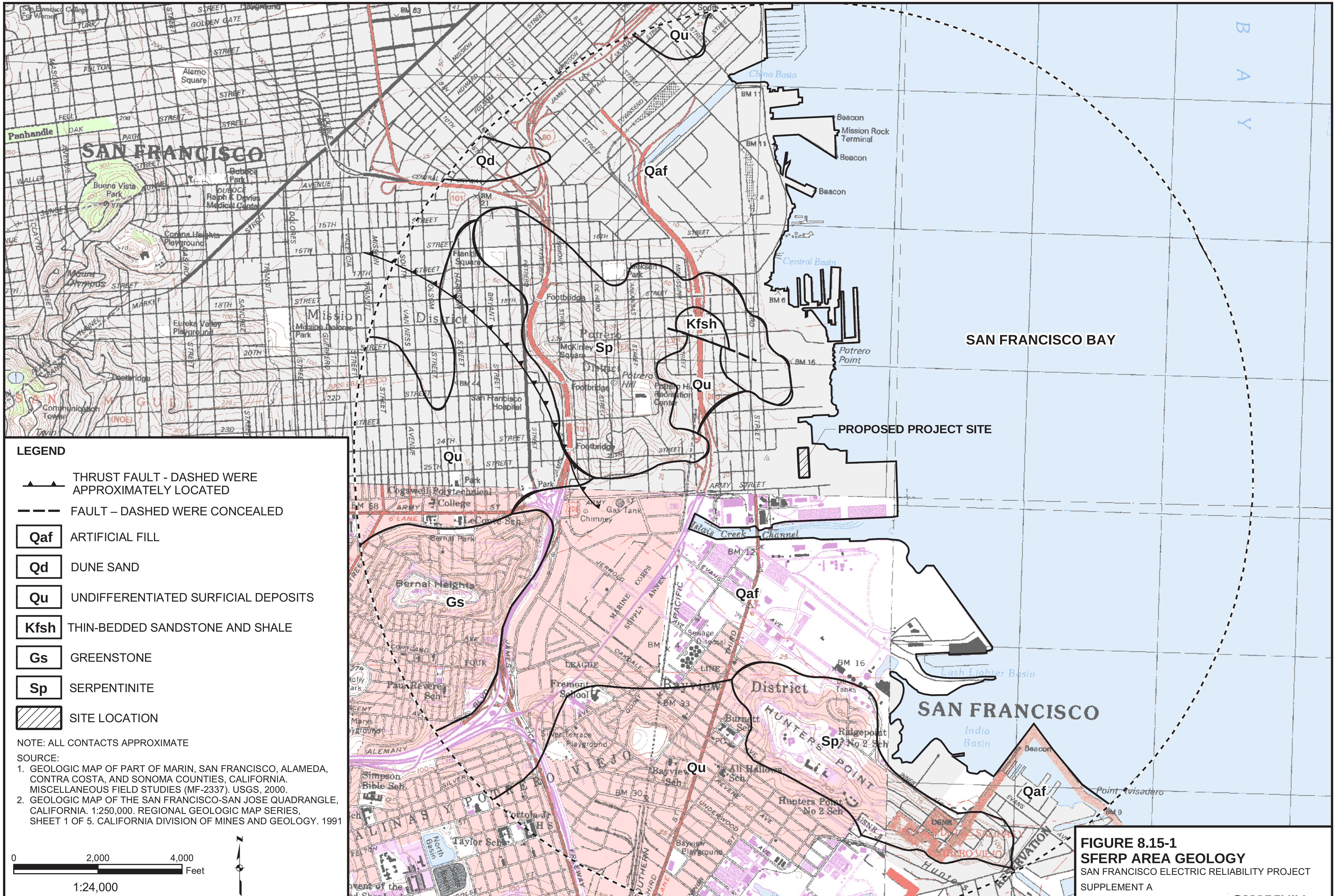
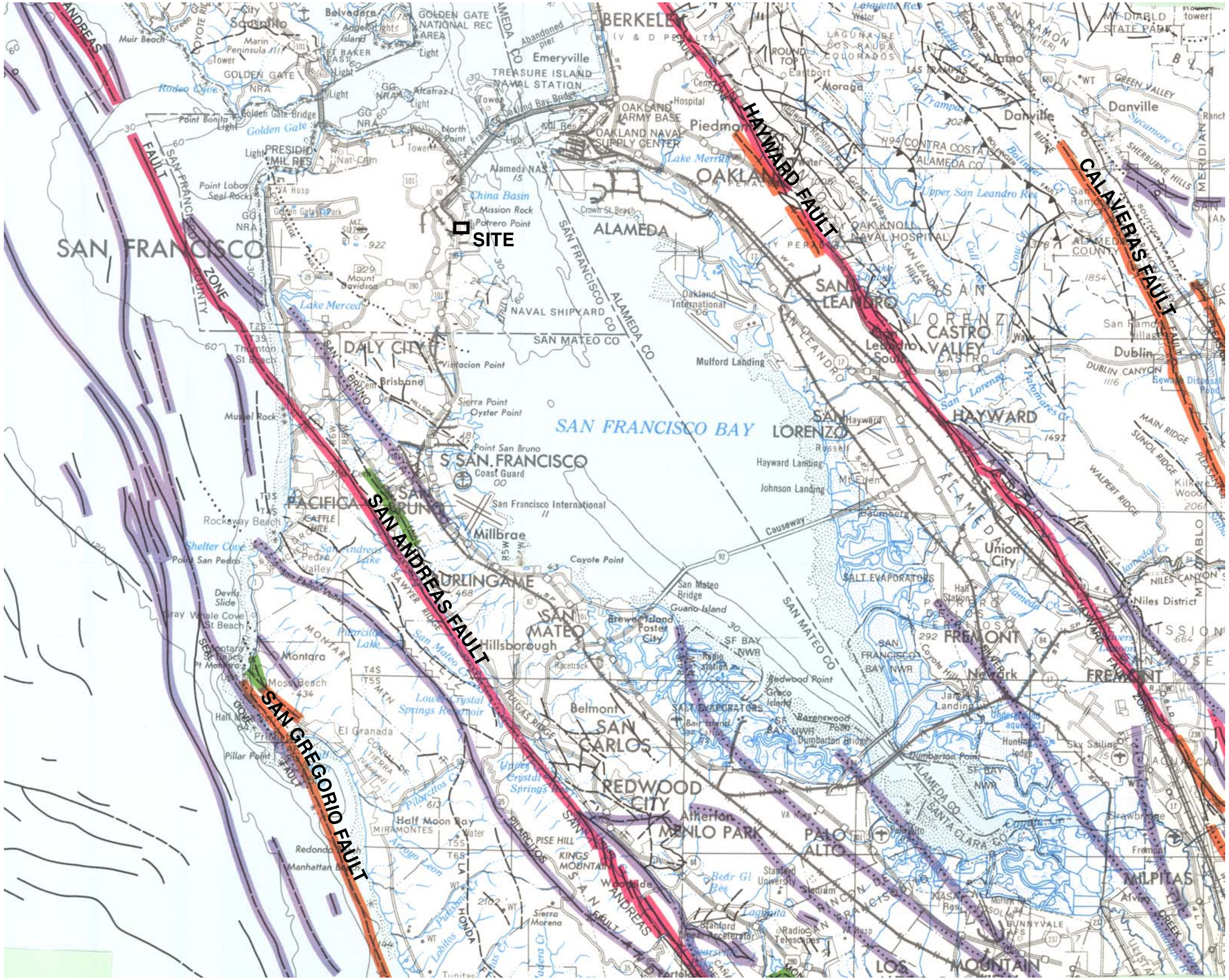


FIGURE 8.15-1
SFERP AREA GEOLOGY
SAN FRANCISCO ELECTRIC RELIABILITY PROJECT
SUPPLEMENT A

CH2MHILL



N

SCALE 1:250,000

SOURCE: MAP SHOWING RECENCY OF FAULTING, SAN FRANCISCO-SAN JOSE QUADRANGLE, CALIFORNIA. REGIONAL GEOLOGIC MAP SERIES SHEET 5 OF 5. CA. DEPT. OF CONSERVATION DIV. OF MINES AND GEOLOGY 1991.

FIGURE 8.15-2
SFERP IN RELATION TO PRINCIPAL FAULT ZONES
SAN FRANCISCO ELECTRIC RELIABILITY PROJECT
SUPPLEMENT A

CH2MHILL

T022005001RDD_16 (2/22/05)